

## DISCRETE MATHEMATICAL STRUCTURES

<b>MAT 203</b>	<b>DISCRETE MATHEMATICAL STRUCTURES</b>	<b>CATEGORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>CREDITS</b>
		BSC	3	1	0	4

**Preamble:**

The purpose of this course is to create awareness in students about the basic terminologies used in advanced courses in Computer Science and develop rigorous logical thinking for solving different kinds of problems in Computer Science. This course helps the learner to apply the theory and applications of elementary Counting Principles, Propositional Logic, Predicate Logic, Lattices, Generating Functions, Recurrence Relations and Algebraic Structures eventually in practical applications.

**Prerequisite:** A sound background in higher secondary school Mathematics

**Course Outcomes:** After the completion of the course the student will be able to

CO#	CO
CO1	Check the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic <b>(Cognitive Knowledge Level: Apply)</b>
CO2	Solve counting problems by applying the elementary counting techniques - Rule of Sum, Rule of Product, Permutation, Combination, Binomial Theorem, Pigeonhole Principle and Principle of Inclusion and Exclusion <b>(Cognitive Knowledge Level: Apply)</b>
CO3	Classify binary relations into various types and illustrate an application for each type of binary relation, in Computer Science <b>(Cognitive Knowledge Level: Understand)</b>
CO4	Illustrate an application for Partially Ordered Sets and Complete Lattices, in Computer Science <b>(Cognitive Knowledge Level: Apply)</b>
CO5	Explain Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients <b>(Cognitive Knowledge Level: Apply)</b>
CO6	Illustrate the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups <b>(Cognitive Knowledge Level: Understand)</b>

### Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓	✓								✓
CO6	✓	✓	✓	✓								✓

#### Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

#### Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

## Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

### Continuous Internal Evaluation Pattern:

Attendance	10 marks
Continuous Assessment Tests (Average of Series Tests 1 & 2)	25 marks
Continuous Assessment Assignment	15 marks

### Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

### End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

## Syllabus

### Module – 1 (Fundamentals of Logic)

Mathematical logic - Basic connectives and truth table, Statements, Logical Connectives, Tautology, Contradiction. Logical Equivalence - The Laws of Logic, The Principle of duality, Substitution Rules . The implication - The Contrapositive, The Converse, The Inverse.

Logical Implication - Rules of Inference. The use of Quantifiers - Open Statement, Quantifier. Logically Equivalent – Contrapositive, Converse , Inverse , Logical equivalences and implications for quantified statement, Implications , Negation .

### **Module - 2 (Fundamentals of Counting Theory)**

The Rule of Sum – Extension of Sum Rule . The Rule of Product - Extension of Product Rule . Permutations. Combinations. The Binomial Theorem (without proof). Combination with Repetition. The Pigeon hole Principle. The Principle of Inclusion and Exclusion Theorem (Without Proof) - Generalization of the Principle. Derangements.

### **Module - 3 ( Relations and Functions )**

Cartesian Product - Binary Relation. Function – domain , range-one to one function, Image-restriction. Properties of Relations- Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Anti-symmetric Relations, Partial Order relations, Equivalence Relations, Irreflexive relations.

Partially ordered Set – Hasse Diagram, Maximal-Minimal Element, Least upper bound (lub), Greatest Lower bound(glb) ( Topological sorting Algorithm- excluded). Equivalence Relations and Partitions - Equivalence Class.

Lattice - Dual Lattice , Sub lattice , Properties of glb and lub , Properties of Lattice , Special Lattice , Complete Lattice, Bounded Lattice, Completed Lattice , Distributive Lattice.

### **Module - 4 (Generating Functions and Recurrence Relations)**

Generating Function - Definition and Examples , Calculation techniques, Exponential generating function. First order linear recurrence relations with constant coefficients – homogeneous, non-homogeneous Solution. Second order linear recurrence relations with constant coefficients, homogeneous, non-homogeneous Solution.

### **Module - 5 (Algebraic Structures )**

Algebraic system-properties- Homomorphism and Isomorphism. Semi group and monoid – cyclic monoid , sub semi group and sub monoid, Homomorphism and Isomorphism of Semi group and monoids. Group- Elementary properties, subgroup, symmetric group on three symbols ,The direct product of two groups, Group Homomorphism, Isomorphism of groups, Cyclic group. Rightcosets - Leftcosets. Lagrange's Theorem

### **Text Book**

1. Discrete and Combinatorial Mathematics (An Applied Introduction), Ralph P Grimaldi, B V Ramana , 5<sup>th</sup> Edition, Pearson

## Reference Books

- 1) Kenneth H. Rosen, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, MGH, 2011
- 2) Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata Mc Graw Hill Pub. Co. Ltd., New Delhi, 2003.
- 3) Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, "Discrete Mathematical Structures", Pearson Education Pvt Ltd., New Delhi, 2003
- 4) Kenneth H. Rosen, "Discrete Mathematics and its Applications", 5/e, Tata Mc Graw Hill Pub. Co. Ltd, New Delhi 2003
- 5) Richard Johnsonbaugh, "Discrete Mathematics", 5/e, Pearson Education Asia, New Delhi, 2002.
- 6) Joe L Mott, Abraham Kandel, Theodore P Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", 2/e, Prentice-Hall India, 2009.

## Course Level Assessment Questions

### Course Outcome 1 (CO1):

1. Show that  $R \vee M$ ,  $\neg R \vee S$ ,  $\neg M$ ,  $\neg S$  cannot exist simultaneously (without using truth table)
2. Represent the following statement in symbolic form "Not every city in Canada is clean".

### Course Outcome 2 (CO2):

1. How many possible arrangements are there for the letters in MASSASAUGA in which 4 A's are together?
2. Find the number of integers between 1 and 1000 inclusive, which are not divisible by 5, 6 or 8

### Course Outcome 3 (CO3):

1. If  $A = \{1, 2, 3, 4\}$ , give an example of a relation  $R$  that is reflexive and symmetric but not transitive.
2. Let  $Z$  be the set of integers.  $R$  is a relation called "Congruence Modulo 3" defined by  $R = \{(x, y) / x \in Z, y \in Z, x - y \text{ is divisible by } 3\}$ . Show that  $R$  is an equivalence relation.

### Course Outcome 4 (CO4):

1. Assume  $A = \{a, b, c\}$ . Let  $P(A)$  be its power set and ' $\leq$ ' be the subset relation on the power set. Draw the Hasse diagram of  $(P(A), \leq)$ .
2. What is meant by Bounded Lattice? Give an example.

### Course Outcome 5 (CO5):

1. Solve  $a_r - 3a_{r-1} - 4a_{r-2} = 3^r$  using Generating function method; Given  $a_0 = 1, a_1 = 2$ .
2. Find the generating function for the sequence  $1, 3, 3^2, 3^3, \dots$

### Course Outcome 6 (CO6):

1. Prove that the group  $\{1, -1, i, -i\}$  is cyclic with generators  $i$  and  $-i$ .
2. State and prove Lagrange's Theorem.

## Model Question Paper

QP CODE:

Reg No: \_\_\_\_\_

Name : \_\_\_\_\_

PAGES : 3

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY  
THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT 203

Course Name: Discrete Mathematical Structures

Max.Marks :100

Duration: 3 Hrs

### PART A

Answer all Questions. Each question carries 3 Marks

1. Show the following implication without constructing the truth table:  $(P \wedge Q) \Rightarrow P \rightarrow Q$
2. Write the negation of the following statement. "If I drive, then I will not walk"
3. What is pigeon hole principle? Explain. If you select any five numbers from 1 to 8 then prove that at least two of them will add up to 9 .
4. In how many ways can the letters of the word ALLAHABAD be arranged ?
5. Show that the divisibility relation  $' / '$  is a partial ordering on the set  $Z^+$ .
6. Consider the functions given by  $f(x) = 2x+3$  and  $g(x) = x^2$ . Find  $(g \circ f)$  and  $(f \circ g)$ .
7. What is meant by exponential generating function? Explain.
8. Provide one example of linear homogeneous recurrence relation. Mention the degree also.
9. What is a monoid ? Explain.
10. Let  $(A, .)$  be a group. Show that  $(ab)^{-1} = b^{-1}a^{-1}$

(10 x 3 = 30 Marks)

### PART B

(Answer any one Question from each Module. Each question carries 14 Marks)

11.  
(a) Show that  $S \vee R$  is tautologically implied by  $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$

(6 marks)

(b) Show that from

(ii)  $(\exists x)(F(x) \wedge S(x)) \rightarrow (y)(M(y) \rightarrow W(y))$ .

(iii)  $(\exists y)(M(y) \wedge \neg W(y))$  the conclusion  $(x)(F(x) \rightarrow \neg S(x))$  follows.

**(8 marks)**

**OR**

12.

(a) Show that  $(x)(P(x) \vee Q(x)) \Rightarrow ((x)P(x) \vee (\exists x)Q(x))$  using indirect method of proof.

**(6 marks)**

(b) Discuss indirect method of proof. Show that the following premises are inconsistent

(i) If Jack misses many classes through illness, then he fails high school.

(ii) If Jack fails high school, then he is uneducated.

(iii) If Jack reads a lot of books, then he is not uneducated.

(iv) Jack misses many classes through illness and reads a lot of books.

**(8 marks)**

13.

(a) Explain binomial theorem. Determine the coefficient of  $x^9y^3$  in the expansion of  $(x+y)^{12}$ ,  $(x+2y)^{12}$  and  $(2x-3y)^{12}$  using binomial theorem.

**(6 marks)**

(b) How many 5 digit numbers can be formed from the digits 1,2,3,4,5 using the digits without repetition?

(i) How many of them are even?

(ii) How many are even and greater than 30,000?

**(8 marks)**

**OR**

14.

(a) There are 8 guests in a party. Each guest brings a gift and receives another gift in return. No one is allowed to receive the gift they bought. How many ways are there to distribute the gifts?

**(6 marks)**

(b) Six papers are set in an examination of which two are mathematical. Only one examination will be conducted in a day. In how many different orders, can the papers be arranged so that

(i) Two mathematical papers are consecutive?

(ii) Two mathematical papers are not consecutive?

**(8 marks)**

15.

- (a) Let  $A = \{1,2,3,4,\dots,11,12\}$  and let  $R$  be the equivalence relation on  $A \times A$  defined by  $(a,b) R (c,d)$  iff  $a+d = b+c$ . Prove that  $R$  is an equivalence relation and find the equivalence class of  $(2,5)$  **(8 marks)**
- (b) What is a chain lattice? Explain. Also show that every chain is a distributive lattice. **(6 marks)**

OR

16. (a) Suppose  $f(x) = x+2$ ,  $g(x) = x-2$ , and  $h(x) = 3x$  for  $x \in \mathbb{R}$ , where  $\mathbb{R}$  is the set of real numbers. Find  $(g \circ f)$ ,  $(f \circ g)$ ,  $(f \circ f)$  and  $(g \circ g)$  **(8 marks)**
- (b) Let  $R$  and  $S$  be two relations on a set  $A$ . If  $R$  and  $S$  are symmetric, Prove that  $(R \cap S)$  is also symmetric. **(6 marks)**

17. (a) Solve the recurrence relation  $a_r - 7a_{r-1} + 10a_{r-2} = 0$  for  $r \geq 2$ ; Given  $a_0 = 0$ ;  $a_1 = 41$  using generating functions **(8 marks)**
- (b) Solve the recurrence relation  $a_r - 4a_{r-1} + 4a_{r-2} = (r+1)^2$  using generating function. **(6 marks)**

OR

18. (a) Solve  $a_n - 3a_{n-1} + 2$ ;  $a_0 = 1$   $n \geq 1$ , using generating functions. **(8 marks)**
- (b) Use generating function to solve the following recurrence relation  $a_n = 2a_{n-1} + 2^n$ ; with  $a_0 = 2$ . **(6 marks)**

19. (a) Prove that the set 'Q' of rational numbers other than 1 forms an abelian group with respect to the operation '\*' defined by  $a * b = a+b-ab$ . **(8 Marks)**
- (b) Show that the direct product of two group is a group. **(6 Marks)**

OR

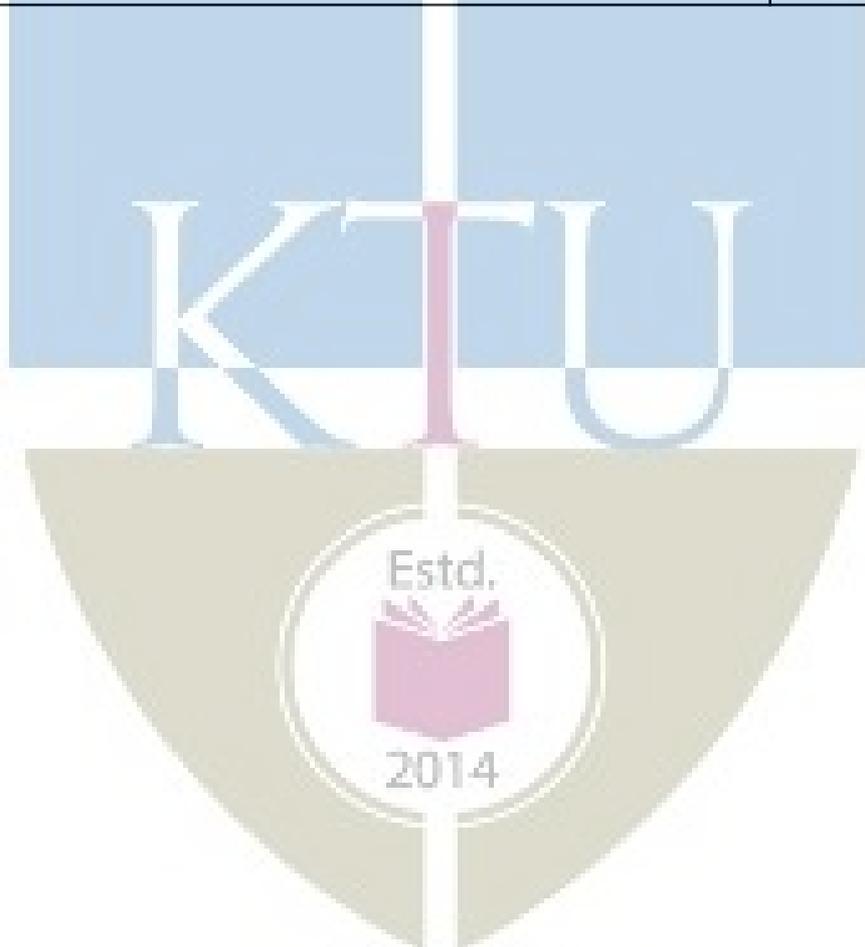
20. (a) Show that the subgroup of a cyclic group is cyclic. **(8 Marks)**
- (b) Let  $(A, *)$  be a group. Show that  $(A, *)$  is an abelian group if and only if  $a^2 * b^2 = (a*b)^2$  for all 'a' and 'b' in A **(6 Marks)**

## TEACHING PLAN

No	Contents	No of Lecture Hrs
<b>Module – 1 (Fundamentals of Logic) (9 hrs)</b>		
1.1	Mathematical logic, Basic Connectives and Truth Table	1
1.2	Statements, Logical Connectives, Tautology, Contradiction	1
1.3	Logical Equivalence, The Laws of Logic	1
1.4	The Principle of duality, Substitution Rules	1
1.5	The implication, The Contrapositive, the Converse , the Inverse	1
1.6	Logical Implication, Rules of Inference, Logical Implication	1
1.7	The use of Quantifiers, Open Statement, Quantifier, Negation	1
1.8	Logically Equivalent, Contrapositive, The Converse, The Inverse	1
1.9	Logical Implications	1
<b>Module - 2 (Fundamentals of Counting Theory) (9 hrs)</b>		
2.1	The Pigeon-hole Principle	1
2.2	The Rule of Sum	1
2.3	Extension of Sum Rule	1
2.4	The Rule of Product	1
2.5	Extension of Product Rule , Permutations	1
2.6	Combinations, Combination with repetition	1
2.7	The Binomial Theorem	1
2.8	The Principle of Inclusion and Exclusion Theorem ( Without Proof) Generalization of the Principle	1
2.9	Derangements	1
<b>Module - 3 ( Relations and Functions) (9 hrs)</b>		
3.1	Cartesian Product, Binary Relation, Function, Domain, Range , One to One Function Image - Restriction	1
3.2	Properties, Reachability Relations, Reflexive Relations, Symmetric Relations, Transitive relations, Antisymmetric Relations.	1

3.3	Partial Order relations	1
3.4	Equivalence Relation, Irreflexive Relations.	1
3.5	Partially ordered Set, Hasse Diagram.	1
3.6	Maximal-Minimal Element, Least Upper bound, Greatest Lower Bound	1
3.7	Equivalence Relations and Partitions, Equivalence Class	1
3.8	Lattice- Dual Lattice, sub lattice, Properties of glb and lub	1
3.9	Properties of Lattice, Special Lattice, Complete Lattice, Bounded Lattice, Completed Lattice, Distributive Lattice	1
<b>Module - 4 (Generating Functions and Recurrence Relations) (9 hrs)</b>		
4.1	Generating Function, Definition and Examples	1
4.2	Exponential Generating Function.	1
4.3	First Order Linear Recurrence Relations with Constant Coefficients (Lecture I)	1
4.4	First Order Linear Recurrence Relations with Constant Coefficients (Lecture II)	1
4.5	Homogeneous Solution	1
4.6	Non homogeneous Solution	1
4.7	Second order linear recurrence relations with constant coefficients	1
4.8	Homogeneous Solution	1
4.9	Non homogeneous Solution	1
<b>Module - 5 (Algebraic Structures) (9 hrs)</b>		
5.1	Algebraic System-Properties, Homomorphism and Isomorphism	1
5.2	Semi group, Monoid, Cyclic monoid	1

5.3	Sub semigroup and sub monoid	1
5.4	Homomorphism and Isomorphism of Semigroup, Monoids and Groups	1
5.5	Elementary Properties, Subgroup, Symmetric group on three symbols	1
5.6	The direct Product of two Groups	1
5.7	Group Homomorphism, Isomorphism, Cyclic group	1
5.8	Right coset, Left coset	1
5.9	Lagrange's Theorem	1



CST201	DATA STRUCTURES	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0		4

**Preamble:** This course aims at moulding the learner to understand the various data structures, their organization and operations. The course helps the learners to assess the applicability of different data structures and associated algorithms for solving real world problem which requires to compare and select appropriate data structures to solve the problem efficiently. This course introduces abstract concepts for data organization and manipulation using data structures such as stacks, queues, linked lists, binary trees, heaps and graphs for designing their own data structures to solve practical application problems in various fields of Computer Science.

**Prerequisite:** Topics covered under the course Programming in C (EST 102)

CO1	Design an algorithm for a computational task and calculate the time/space complexities of that algorithm ( <b>Cognitive Knowledge Level: Apply</b> )
CO2	Identify the suitable data structure (array or linked list) to represent a data item required to be processed to solve a given computational problem and write an algorithm to find the solution of the computational problem ( <b>Cognitive Knowledge Level: Apply</b> )
CO3	Write an algorithm to find the solution of a computational problem by selecting an appropriate data structure (binary tree/graph) to represent a data item to be processed ( <b>Cognitive Knowledge Level: Apply</b> )
CO4	Store a given dataset using an appropriate Hash Function to enable efficient access of data in the given set ( <b>Cognitive Knowledge Level: Apply</b> )
CO5	Select appropriate sorting algorithms to be used in specific circumstances ( <b>Cognitive Knowledge Level: Analyze</b> )
CO6	Design and implement Data Structures for solving real world problems efficiently ( <b>Cognitive Knowledge Level: Apply</b> )

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓						✓
CO2	✓	✓	✓	✓		✓						✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓	✓		✓						✓
CO6	✓	✓	✓	✓		✓						✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
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PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

**Assessment Pattern**

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
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Apply	40	40	40

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Create			

**Mark Distribution**

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

**Continuous Internal Evaluation Pattern:**

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

## SYLLABUS

### Module 1

#### **Basic Concepts of Data Structures**

System Life Cycle, Algorithms, Performance Analysis, Space Complexity, Time Complexity, Asymptotic Notation, Complexity Calculation of Simple Algorithms

### Module 2

#### **Arrays and Searching**

Polynomial representation using Arrays, Sparse matrix, Stacks, Queues-Circular Queues, Priority Queues, Double Ended Queues, Evaluation of Expressions

Linear Search and Binary Search

### Module 3

#### **Linked List and Memory Management**

Self Referential Structures, Dynamic Memory Allocation, Singly Linked List-Operations on Linked List. Doubly Linked List, Circular Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List

Memory allocation and de-allocation-First-fit, Best-fit and Worst-fit allocation schemes

### Module 4

#### **Trees and Graphs**

Trees, Binary Trees-Tree Operations, Binary Tree Representation, Tree Traversals, Binary Search Trees- Binary Search Tree Operations

Graphs, Representation of Graphs, Depth First Search and Breadth First Search on Graphs, Applications of Graphs

### Module 5

#### **Sorting and Hashing**

Sorting Techniques – Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort

Hashing- Hashing Techniques, Collision Resolution, Overflow handling, Hashing functions – Mid square, Division, Folding, Digit Analysis

#### **Text Book**

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Universities Press, Fundamentals of Data Structures in C

**Reference Books**

1. Samanta D., Classic Data Structures, Prentice Hall India.
2. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, 2/e, Cengage Learning.
3. Aho A. V., J. E. Hopcroft and J. D. Ullman, Data Structures and Algorithms, Pearson Publication.
4. Tremblay J. P. and P. G. Sorenson, Introduction to Data Structures with Applications, Tata McGraw Hill.
5. Peter Brass, Advanced Data Structures, Cambridge University Press.
6. Lipschuts S., Theory and Problems of Data Structures, Schaum's Series.
7. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall.
8. Hugges J. K. and J. I. Michtm, A Structured Approach to Programming, PHI.
9. Martin Barrett, Clifford Wagner, C And Unix: Tools For Software Design, John Wiley.

**Sample Course Level Assessment Questions**

**Course Outcome1(CO1):** Write an algorithm for matrix multiplication and calculate its time complexity.

**Course Outcome 2(CO2):** How a linked list can be used to represent the polynomial  $5x^4y^6+24x^3y^4-17x^2y^3+15xy^2+45$ . Write an algorithm to add two Bivariate polynomials represented using linked list.

**Course Outcome 3(CO3):** Create a Binary search Tree with node representing the following sequence 14, 15, 4, 18, 9, 16, 20, 17, 3, 7, 5, 2 and perform inorder, preorder and postorder traversals on the above tree and print the output.

**Course Outcome 4(CO4):** The size of a hash table is 7. The index of the hash table varies from 0 to 6. Consider the keys 89, 18, 49, 58, 25 in the order. Show how the keys are stored in the hash table using Linear probing.

**Course Outcome 5(CO5):** In what circumstances does Quick Sort perform over Merge sort.

**Course Outcome 6(CO6):** Design a reservation system for railways that include waiting list. If the reservation is full “Display reservation full” and put the passenger in in waiting list and give a waiting list number. If a passenger cancels the ticket, then the seat should be automatically allocated to the first passenger in the waiting list.

### Model Question Paper

QP CODE: \_\_\_\_\_

PAGES:3

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH  
DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST 201**

**Course Name: DATA STRUCTURES**

**Max.Marks:100**

**Duration: 3 Hours**

**PART A**

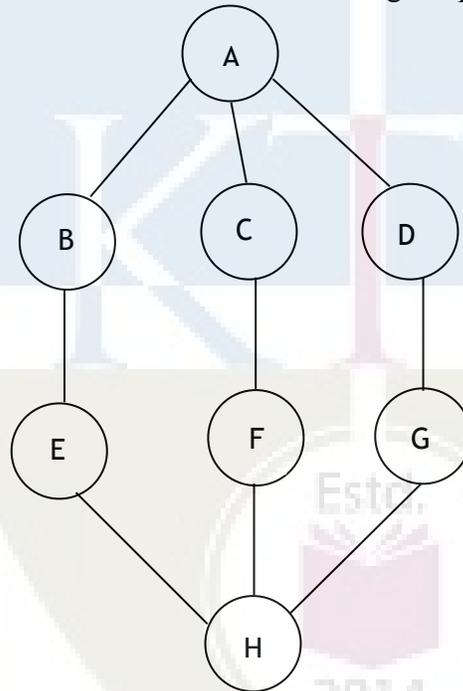
**Answer all Questions. Each question carries 3 Marks**

1. Calculate the frequency count of the statement  $x = x + 1$ ; in the following code segment  
for ( $i = 0$ ;  $i < n$ ;  $i++$ )  
for ( $j = 0$ ;  $j < n$ ;  $j *= 2$ )  
 $x = x + 1$ ;
2. What is the relevance of verification in System Life Cycle?
3. Write an algorithm to insert a new element in a particular position of an array.

4. Convert the expression  $((A/(B-D+E))*(F-G)*H)$  to postfix form. Show each step in the conversion including the stack contents
5. Write an algorithm to count the number of occurrences of a character in a linked list (each node contains only one character)
6. Write an algorithm for best-fit method of memory allocation
7. Draw the binary tree whose sequential representation is given below

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	B	C	-	D	E	-	-	-	-	F	G	-	-	-

8. Find the Depth First Search of the following Graph



9. Write an algorithm to arrange  $n$  numbers in nonincreasing order.
10. Let the size of a hash table is 10. The index of the hash table varies from 0 to 9. Assume the keys 73, 54, 15, 48, 89, 66, 37, 18, 41, 22, 62 are mapped using modulo operator. Show how the keys are distributed using chaining method.

**Part B**

**Answer any one Question from each module. Each question carries 14 Marks**

11. a) Explain the System Life Cycle in detail (10)

b) How the performance of an algorithm is evaluated? (4)

**OR**

12. a) Write algorithms for Linear Search and Binary Search and Compare their time complexities (10)

b) Between  $O(n \log n)$  and  $O(\log n)$  which one is better and why? (4)

13. a) Write algorithms to insert and delete elements from a double ended queue. Demonstrate with examples (10)

b) Compare and contrast Circular Queue with a Normal Queue (4)

**OR**

14. a) Write an algorithm to insert and delete elements from a Priority Queue (8)

b) Discuss an algorithm to convert an infix expression to a prefix expression (6)

15. a) Write an algorithm to multiply two polynomials represented using linked list (10)

b) How doubly linked list can be used to find palindromes ? (4)

**OR**

16. a) How is memory compaction (de-allocation) done in memory management ? (8)

b) Discuss the advantages and disadvantages of First-fit, Best-fit and Worst-fit allocation schemes (6)

17. a) List the properties of Binary Search Tree. Write an algorithm to search an element from a Binary Search Tree (10)

b) Write an iterative algorithm for in-order traversal of a Binary Tree (4)

**OR**

18. a) Give algorithms for DFS and BFS of a graph and explain with examples (8)

b) How graphs can be represented in a Computer? (6)

19. a) Write algorithms for Merge sort and Quick Sort. (10)

b) Illustrate the working of Quick sort on the following input 38, 8, 0, 28, 45, -12, 89, 66, 42 (4)

**OR**

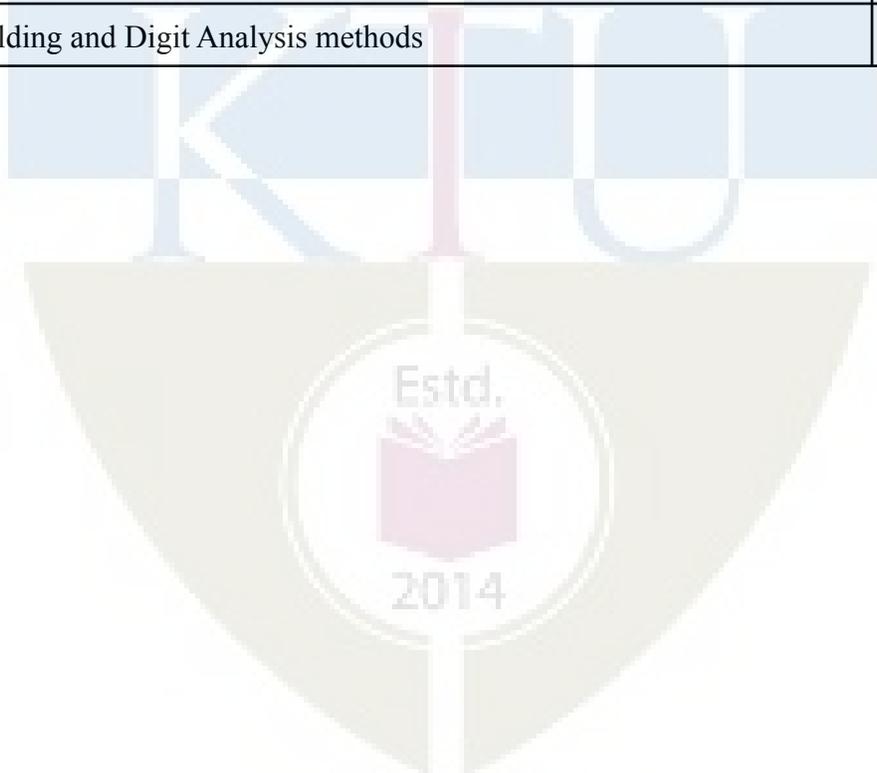
20. a) With examples discuss the different hash functions used for hashing (10)

b) Apply the hash function  $h(x) = x \text{ mod } 7$  for linear probing on the data 2341, 4234, 2839, 430, 22, 397, 3920 and show the resulting hash table (4)

<b>Teaching Plan</b>		
<b>Module 1 :Basic Concepts of Data Structures</b>		(5 hours)
1.1	System Life Cycle,	1 hour
1.2	Algorithms , Performance Analysis	1 hour
1.3	Space Complexity, Time Complexity	1 hour
1.4	Asymptotic Notation (Big O Notation)	1 hour
1.5	Complexity Calculation of Simple Algorithms	1hour
<b>Module 2 :Arrays and Searching</b>		(10 hours)
2.1	Polynomial representation using Arrays	1 hour
2.2	Sparse matrix (Lecture 1)	1 hour
2.3	Sparse matrix (Lecture 2)	1 hour

2.4	Stacks	1 hour
2.5	Queues, Circular Queues	1 hour
2.6	Priority Queues,	1 hour
2.7	Double Ended Queues,	1 hour
2.8	Conversion and Evaluation of Expressions (Lecture 1)	1 hour
2.9	Conversion and Evaluation of Expressions (Lecture 2)	1 hour
2.10	Linear Search and Binary Search	1 hour
<b>Module 3 : Linked List and Memory Management</b>		<b>(12 hours)</b>
3.1	Self Referential Structures	1 hour
3.2	Dynamic Memory Allocation	1 hour
3.3	Singly Linked List-Operations on Linked List,	1 hour
3.4	Doubly Linked List	1 hour
3.5	Circular Linked List	1 hour
3.6	Stacks using Linked List	1 hour
3.7	Queues using Linked List	1 hour
3.8	Polynomial representation using Linked List (Lecture 1)	1 hour
3.9	Polynomial representation using Linked List (Lecture2)	1 hour
3.10	Memory de-allocation	1 hour
3.11	Memory allocation-First-fit	1 hour
3.12	Best-fit and Worst-fit allocation schemes	1 hour
<b>Module 4 :Trees and Graphs</b>		<b>(8 hours)</b>
4.1	Trees, Binary Trees	1 hour
4.2	Tree Operations, Binary Tree Representation,	1 hour
4.3	Tree Traversals	1 hour
4.4	Binary Search Trees	1 hour
4.5	Binary Search Tree Operations	1 hour
4.6	Graphs, Representation of Graphs	1 hour

4.7	Depth First Search and Breadth First Search on Graphs	1hour
4.8	Applications of Graphs	1hour
<b>Module 5 : Sorting and Hashing</b>		(10 hours)
5.1	Sorting Techniques – Selection Sort	1hour
5.2	Insertion Sort	1hour
5.3	Quick Sort	1hour
5.4	Merge Sort	1hour
5.5	Heap Sort	1hour
5.6	Hashing- Hashing Techniques	1hour
5.7	Collision Resolution	1hour
5.8	Overflow handling	1hour
5.9	Hashing functions – Mid square and Division methods	1hour
5.10	Folding and Digit Analysis methods	1hour



<b>CST 203</b>	<b>LOGIC SYSTEM DESIGN</b>	<b>Category</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>	<b>Year of Introduction</b>
		<b>PCC</b>	<b>3</b>	<b>1</b>	<b>0</b>		

**Preamble:** The objective of the course is to familiarize learners with the basic concepts of Boolean algebra and digital systems. This course covers the design of simple combinational and sequential logic circuits, representation and arithmetic algorithms for Binary, BCD (Binary Coded Decimal) and Floating point numbers which in turn are helpful in understanding organization & design of a computer system and understanding how patterns of ones and zeros can be used to store information on computers, including multimedia data.

**Prerequisite:** Nil

**Course Outcomes:** After the completion of the course the student will be able to

<b>CO#</b>	<b>CO</b>
<b>CO1</b>	Illustrate decimal, binary, octal, hexadecimal and BCD number systems, perform conversions among them and do the operations - complementation, addition, subtraction, multiplication and division on binary numbers ( <b>Cognitive Knowledge level: Understand</b> )
<b>CO2</b>	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using Digital Logic Gates ( <b>Cognitive Knowledge level: Apply</b> )
<b>CO3</b>	Design combinational circuits - Adders, Code Convertors, Decoders, Magnitude Comparators, Parity Generator/Checker and design the Programmable Logic Devices - ROM and PLA. ( <b>Cognitive Knowledge level: Apply</b> )
<b>CO4</b>	Design sequential circuits - Registers, Counters and Shift Registers. ( <b>Cognitive Knowledge level: Apply</b> )
<b>CO5</b>	Use algorithms to perform addition and subtraction on binary, BCD and floating point numbers ( <b>Cognitive Knowledge level: Understand</b> )

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓		✓						✓
CO3	✓	✓	✓	✓		✓						✓
CO4	✓	✓	✓	✓		✓						✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

**Assessment Pattern:**

Bloom's Category	Test 1 (%)	Test 2 (%)	End Semester Examination Marks (%)
Remember	20	20	20
Understand	35	35	35
Apply	45	45	45
Analyse			
Evaluate			
Create			

**Mark Distribution:**

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

**Continuous Internal Evaluation Pattern:**

Attendance : 10 marks  
 Continuous Assessment Test : 25 marks  
 Continuous Assessment Assignment : 15 marks

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

**SYLLABUS****Module I****Number systems, Operations & Codes**

Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions. Addition, Subtraction, Multiplication and Division of binary numbers. Representation of negative numbers- Complements, Subtraction with complements. Addition and subtraction of BCD, Octal and Hexadecimal numbers. Binary codes- Decimal codes, Error detection codes, Reflected code, Character coding schemes – ASCII, EBCDIC.

**Module II****Boolean Algebra**

Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Boolean Functions - Canonical and Standard forms. Simplification of Boolean Functions- Using Karnaugh- Map Method (upto five variables), Don't care conditions, Product of sums

simplification, Tabulation Method. Digital Logic Gates- Implementation of Boolean functions using basic and universal gates.

### **Module III**

#### **Combinational Logic Circuits**

Design Procedure & Implementation of combinational logic circuits- Binary adders and subtractors, Binary Parallel adder, Carry look ahead adder, BCD adder, Code converter, Magnitude comparator, Decoder, Demultiplexer, Encoder, Multiplexer, Parity generator/Checker.

### **Module IV**

#### **Sequential logic circuits:**

Flip-flops- SR, JK, T and D. Triggering of flip-flops- Master slave flip-flops, Edge-triggered flip-flops. Excitation table and characteristic equation. Registers- register with parallel load. Counter design: Asynchronous counters- Binary and BCD counters, timing sequences and state diagrams. Synchronous counters- Binary Up-down counter, BCD counter.

### **Module V**

#### **Shift registers**

Shift registers – Serial In Serial Out, Serial In Parallel Out, Bidirectional Shift Register with Parallel load. Ring counter. Johnson counter- timing sequences and state diagrams.

#### **Arithmetic algorithms**

Algorithms for addition and subtraction of binary numbers in signed magnitude and 2's complement representations. Algorithm for addition and subtraction of BCD numbers. Representation of floating point numbers, Algorithm for addition and subtraction of floating point numbers.

#### **Programmable Logic devices**

ROM. Programmable Logic Array(PLA)- Implementation of simple circuits using PLA.

#### **Text Books:**

1. M. Morris Mano, Digital Logic & Computer Design, 4/e, Pearson Education, 2013
2. Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.

#### **Reference Books:**

1. M. Morris Mano, Michael D Ciletti, Digital Design With An Introduction to the Verilog HDL, 5/e, Pearson Education, 2013.
2. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003

**Sample Course Level Assessment Questions**

**Course Outcome1(CO1):** Perform the following number base conversions:

a)  $(250.55)_{10}$  to Hexadecimal

b)  $(357)_8$  to Decimal

**Course Outcome 2(CO2):** Given a Boolean function F and don't care conditions D, using Karnaugh map obtain the simplified expression in (i) SOP and (ii) POS:

$$F(A, B, C, D) = A'B'D' + A'CD + A'BC$$

$$D(A, B, C, D) = A'BC'D + ACD + AB'D$$

**Course Outcome 3(CO3):** Design a BCD to Excess-3 Code Converter.

**Course Outcome 4(CO4):** Design a 4- bit binary ripple counter.

**Course Outcome 5(CO5):** Demonstrate floating-point addition algorithm.



**Model Question Paper**

QP CODE:

PAGES: 2

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B.TECH  
DEGREE EXAMINATION, MONTH & YEAR****Course Code: CST 203****Course name : LOGIC SYSTEM DESIGN****Max Marks: 100****Duration: 3 Hours****PART-A****(Answer All Questions. Each question carries 3 marks)**

1. Represent the decimal numbers  $(459)_{10}$  and  $(859)_{10}$  in hexadecimal and perform addition of these hexadecimal numbers.
2. Subtract  $(1101)_2$  from  $(11010)_2$  using: i) 2's complement and ii) 1's complement arithmetic.
3. Find the dual and complement of the boolean function  $F = AB' + B(A + B')$ .
4. Using K-map, reduce the expression:  $AB + ABC + ABC + BC$ .
5. Design a half subtractor with NAND gates only.
6. Design a combinational circuit that multiplies an input decimal digit by 5 represented in BCD. The output is also in BCD. Show that the outputs can be obtained from the input lines without using any logic gates.
7. Differentiate between ripple counter and synchronous counter.
8. Construct D flip-flop using NAND gates. Also give its truth table.
9. Explain how a shift register is used for serial data transfer?
10. Write short notes on ROM.

**PART-B****(Answer any one full question from each module)****(14X5=70)**

11. (a) Perform the following operations using 2's complement arithmetic: (8)
- (i)  $88_{10} + (-37)_{10}$       (ii)  $(-20)_{10} + (-12)_{10}$

- (b) Perform the following base conversions: (i)  $(101011.11)_2$  to octal (6)  
(ii)  $(3F9B)_{16}$  to binary    (iii)  $(121)_{10}$  to binary    (iv)  $(3077)_8$  to binary

**OR**

12. (a) Find the 12 bit 2's complement representation of the following decimal numbers. (6)

(i)  $-97$       (ii)  $-224$       (iii)  $-197.5$

- (b) Perform the following operations (8)

(i)  $(520)_8 + (488)_8$       (ii)  $(520)_{16} - (488)_{16}$

13. (a) Prove that (i)  $AB + A(B + C) + B(B + C) = B + AC$  (4)  
(ii)  $AB + A(B + C) + B(B + D) = A$

- (b) Using K-map, simplify the Boolean function F in sum of products form, using the don't care conditions d: (10)

$$F(w, x, y, z) = w'(x'y + x'y' + xyz) + x'z'(y + w)$$

$$d(w, x, y, z) = w'x(y'z + yz') + wyz$$

**OR**

14. (a) Simplify the following expressions using Karnaugh- map method. (8)

(i)  $F = \Sigma(0,2,4,6,9,11,13,15,17,21,25,27,29,31)$

(ii)  $F = \Pi(0,2,5,7)$

- (b) Convert the following to the other canonical form: (6)

(i)  $F(x, y, z, a) = \sum (1,3,7)$

(ii)  $F(x, y, z) = \Pi(0,3,6,7)$

(iii)  $F(A, B, C, D) = \Pi(0,1,2,3,4,6,12)$

15. (a) Implement Full adder circuit using NAND gate only. (4)

- (b) Design a code converter for converting BCD to Excess 3 code (10)

**OR**

16. (a) With a neat diagram explain 4-bit carry look-ahead adder. (6)

- (b) Design a Gray to binary code converter using a 4x1 MUX. Draw the circuit diagram and explain. (8)
17. (a) Design a counter that count the states 0,3,5,6,0... using T flip-flops. (10)  
 (b) Write the characteristics equation, excitation table of JK, T and D flipflop. (4)
- OR**
18. (a) Explain race around condition and how it can be avoided. (6)  
 (b) Design a synchronous Binary Up-Down Counter. (8)
19. (a) With a neat diagram explain universal shift register. (8)  
 (b) Explain Johnson Counter with timing diagram. (6)
- OR**
20. (a) Write algorithm for floating point addition and subtraction. (8)  
 (b) Implement the functions  $Y_1 = AB'C' + AB'C + ABC$  and  $Y_2 = BC + AC$  using minimum gates Programmable Logic Array. (6)

**Teaching Plan**

<b>Module 1: Number systems, Operations &amp; Codes (No algorithms)</b>		<b>(7 hours)</b>
<b>1.1</b>	<b>Number Systems:</b> Decimal, Binary, Octal and Hexadecimal number systems, Number Base Conversions.	<b>1 hour</b>
<b>1.2</b>	<b>Binary Arithmetic:</b> Addition, Subtraction, Multiplication & Division of Binary Numbers. (Lecture 1)	<b>1 hour</b>
<b>1.3</b>	Addition, Subtraction, Multiplication & Division of Binary Numbers. (Lecture 2)	<b>1 hour</b>
<b>1.4</b>	Representation of Negative Numbers- Complements, subtraction with complements.	<b>1 hour</b>
<b>1.5</b>	<b>BCD Arithmetic:</b> Addition and Subtraction of BCD Numbers	<b>1 hour</b>
<b>1.6</b>	<b>Octal and Hexadecimal Arithmetic:</b> Addition & Subtraction of Octal and Hexadecimal Numbers.	<b>1 hour</b>

1.7	<b>Binary Codes:</b> Decimal Codes, Error detection codes, Reflected code, Character Coding Schemes-ASCII, EBCDIC	1 hour
<b>Module 2: Boolean Algebra</b>		(9 hours)
2.1	<b>Introduction to Boolean Algebra:</b> Postulates of Boolean Algebra	1 hour
2.2	Basic theorems and Properties of Boolean Algebra	1 hour
2.3	<b>Boolean Functions:</b> Canonical and Standard Forms	1 hour
2.4	<b>Simplification of Boolean Functions:</b> Karnaugh -Map Method (upto five variables), Don't care conditions (Lecture 1)	1 hour
2.5	<b>Simplification of Boolean Functions:</b> Karnaugh -Map Method (upto five variables), Don't care conditions (Lecture 2)	1 hour
2.6	<b>Product of sums simplification</b>	1 hour
2.7	<b>Tabulation method</b>	1 hour
2.8	<b>Digital Logic Gates:</b> AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates. (Lecture 1)	1 hour
2.9	<b>Digital Logic Gates:</b> AND, OR, NOT, NAND, NOR, XOR, XNOR, Implementation of Boolean functions using basic and universal gates. (Lecture 2)	1 hour
<b>Module 3: Combinational Logic Circuits</b>		(9 hours)
3.1	Design Procedure & Implementation of Combinational Circuits	1 hour
3.2	<b>Binary Adders:</b> Implementation of Half Adder, Full Adder	1 hour
3.3	<b>Binary Subtractors:</b> Implementation of Half Subtractor, Full Subtractor	1 hour
3.4	Implementation of Binary Parallel Adder ,Carry look ahead Adder, BCD Adder (Lecture 1)	1 hour
3.5	Implementation of Binary Parallel Adder ,Carry look ahead Adder, BCD Adder (Lecture 2)	1 hour

<b>3.6</b>	<b>Implementation of Various Combinational Circuits:</b> Code Converters, Magnitude Comparator	<b>1 hour</b>
<b>3.7</b>	Implementation of Decoder, Demultiplexer	<b>1 hour</b>
<b>3.8</b>	Implementation of Encoder, Multiplexer	<b>1 hour</b>
<b>3.9</b>	Implementation of Parity Generator/Checker	<b>1 hour</b>
<b>Module 4: Sequential logic circuits:</b>		<b>(9 hours)</b>
<b>4.1</b>	<b>Flip flops:</b> SR, JK, T and D flip- flops (Lecture 1)	<b>1 hour</b>
<b>4.2</b>	SR, JK, T and D flip- flops (Lecture 2)	<b>1 hour</b>
<b>4.3</b>	Triggering of flip-flops- Master slave flip- flop, Edge- triggered flip-flops (Lecture 1)	<b>1 hour</b>
<b>4.4</b>	Triggering of flip-flops- Master slave flip- flop, Edge- triggered flip-flops (Lecture 2)	<b>1 hour</b>
<b>4.5</b>	Excitation table and characteristic equations of flip- flops	<b>1 hour</b>
<b>4.6</b>	<b>Registers-</b> Register with parallel load	<b>1 hour</b>
<b>4.7</b>	<b>Counter Design:</b> Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams. (Lecture 1)	<b>1 hour</b>
<b>4.8</b>	Asynchronous counters- Binary and BCD counters- timing sequences and state diagrams. (Lecture 2)	<b>1 hour</b>
<b>4.9</b>	Synchronous counters- Binary Up- down counter, BCD counter	<b>1 hour</b>
<b>Module 5: Shift registers, Arithmetic algorithms &amp; PLD's</b>		<b>(11 hours)</b>
<b>5.1</b>	<b>Shift Registers</b> - Serial In Serial Out, Serial In Parallel Out.	<b>1 hour</b>
<b>5.2</b>	Bidirectional Shift Register with Parallel load	<b>1 hour</b>

5.3	<b>Shift register counters</b> - Ring Counter, Johnson Counter- timing sequences and state diagrams	<b>1 hour</b>
5.4	<b>Arithmetic Algorithms:</b> Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations (Lecture 1)	<b>1 hour</b>
5.5	Algorithm for addition and subtraction of binary numbers in Signed magnitude and 2's complement representations (Lecture 2)	<b>1 hour</b>
5.6	Algorithm for addition and subtraction of BCD numbers	<b>1 hour</b>
5.7	Representation of floating point numbers (IEEE Standard representations).	<b>1 hour</b>
5.8	Algorithms for floating point addition and subtraction	<b>1 hour</b>
5.9	<b>Programmable Logic devices</b> - ROM	<b>1 hour</b>
5.10	PLA, Implementation of simple circuits using PLA(Lecture 1)	<b>1 hour</b>
5.11	PLA, Implementation of simple circuits using PLA(Lecture 2)	<b>1 hour</b>



CST 205	OBJECT ORIENTED PROGRAMMING USING JAVA	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	3	1	0	4	2019

**Preamble:** The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Inheritance, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course helps the learners to develop Desktop GUI Applications, Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

**Prerequisite:** Topics covered under the course PROGRAMMING IN C (EST 102)

Course Outcomes: After the completion of the course the student will be able to

CO1	Write Java programs using the object oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism (Cognitive Knowledge Level: <b>Apply</b> )
CO2	Utilise datatypes, operators, control statements, built in packages & interfaces, Input/ Output Streams and Files in Java to develop programs (Cognitive Knowledge Level: <b>Apply</b> )
CO3	Illustrate how robust programs can be written in Java using exception handling mechanism (Cognitive Knowledge Level: <b>Understand</b> )
CO4	Write application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: <b>Apply</b> )
CO5	Write Graphical User Interface based application programs by utilising event handling features and Swing in Java (Cognitive Knowledge Level: <b>Apply</b> )

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓						✓		✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

**Assessment Pattern**

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (Marks %)	Test2 (Marks %)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse			
Evaluate			
Create			

## Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

**Continuous Internal Evaluation Pattern:**

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

**Internal Examination Pattern:**

Each of the two internal examinations has to be conducted out of 50 marks

First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

**End Semester Examination Pattern:** There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

## SYLLABUS

### Object Oriented Programming Using Java

#### Module 1

##### Introduction:

Approaches to Software Design - Functional Oriented Design, Object Oriented Design, Case Study of Automated Fire Alarm System.

Object Modeling Using Unified Modeling Language (UML) – Basic Object Oriented concepts, UML diagrams, Use case model, Class diagram, Interaction diagram, Activity diagram, State chart diagram.

Introduction to Java - Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

#### Module 2

##### Core Java Fundamentals:

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.

Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.

Control Statements - Selection Statements, Iteration Statements and Jump Statements.

Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, *this* Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Final Variables, Inner Classes, Command Line Arguments, Variable Length Arguments.

Inheritance - Super Class, Sub Class, The Keyword *super*, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, using *final* with Inheritance.

#### Module 3

##### More features of Java:

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.

Exception Handling - Checked Exceptions, Unchecked Exceptions, *try* Block and *catch* Clause, Multiple *catch* Clauses, Nested *try* Statements, *throw*, *throws* and *finally*.

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Object Streams and Serialization, Working with Files.

## Module 4

### Advanced features of Java:

Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, using valueOf(), Comparison of StringBuffer and String.

Collections framework - Collections overview, Collections Interfaces- Collection Interface, List Interface.

Collections Class – ArrayList class. Accessing a Collection via an Iterator.

Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.

## Module 5

### Graphical User Interface and Database support of Java:

Swings fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings –JFrame, JLabel, The Swing Buttons, JTextField.

Java DataBase Connectivity (JDBC) - JDBC overview, Creating and Executing Queries – create table, delete, insert, select.

### Text Books:

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Rajib Mall, Fundamentals of Software Engineering, 4<sup>th</sup> edition, PHI, 2014.
3. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11<sup>th</sup> Edition, Pearson, 2018.

### Reference Books:

1. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
2. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
3. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
4. Barclay K., J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.
6. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

## Sample Course Level Assessment Questions

**Course Outcome1(CO1):** For the following passage develop UML diagrams and then implement it as a Java program in accordance with your UML design.

**Passage:** College Office collects semester fee and college bus fee for each student. A clerk at the college office collects the fees from each student. The bus fee is calculated depending on the distance of the corresponding bus stop from the college. The semester fee varies depending upon the semester as well as branch of each student. Students are supposed to pay the fees in full. Economically backward students are eligible for 50% discount in semester fee. The consolidated fees receipt is issued to each student by the clerk, which contains the student name, admission number, semester and branch of student along with details of fees collected. Students can log in and view the details of fees remitted and dues if any. The system allows students and clerk level login to the system. Clerk is able to view reports of each class showing status of fees payment of each student.

**Course Outcome 2(CO2):** Write a Java program to evaluate a post fix expression containing two operands and a single operator using stack. Stack should be implemented as a separate entity so as to reflect OOP concepts.

**Course Outcome 3(CO3):** Write a program to demonstrate the start, run, sleep and join methods in Thread class.

**Course Outcome 4(CO4):** Write a GUI based program with separate buttons to add, delete and display student details i.e. name, student ID, current semester and branch of study based on student ID.

**Course Outcome 5(CO5):** Using Swing create a JFrame with a JLabel and two JButtons. Set the texts of JButtons as “Yes” and “No” respectively. Set the JLabel’s text to the text of the button currently being pressed. Initially the JLabel’s text is blank.

**Model Question Paper**

QP CODE:

PAGES:3

Reg No: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR**

**Course Code: CST 205**

**Course Name: Object Oriented Programming using Java**

**Max.Marks:100**

**Duration: 3 Hours**

**PART A**

**Answer all Questions. Each question carries 3 Marks**

1. Briefly explain the portable, secure and robust features of Java.
2. Describe the concepts of object and class with a suitable Java program.
3. Explain the concept of method overriding with an example.
4. What is the use of the keyword *final* in Java?
5. Explain the concept of streams.
6. Explain any two applications of Serialization.
7. Distinguish the usage of “==” and *equals()* method when comparing String type?
8. What are Collections in Java? Explain any one Collection interface in Java.
9. Explain any two properties of Swing components in Java.
10. Explain JLabel component. With suitable examples explain any two of its constructors.

**Part B**

**Answer any one question completely from each module**

11.

- (a) Describe in detail any three Object Oriented Programming principles. Illustrate with suitable examples.

(9)

- (b) What is Java Runtime Environment? What is the role of Java Virtual Machine in it? (5)

OR

12.

- (a) Compare and contrast Java standard edition and Java enterprise edition. (5)
- (b) Why is Java considered to be platform independent? What is the role of Bytecode in making Java platform independent? (9)

13.

- (a) Explain in detail the primitive data types in Java. (8)
- (b) Explain automatic type conversion in Java with an example. What are the two conditions required for it? (6)

OR

14.

- (a) Using a suitable Java program explain the difference between *private* and *public* members in the context of inheritance. (8)
- (b) Is it possible to use the keyword *super* within a static method? Give justification for your answer. (6)

15.

- (a) Explain in detail about byte streams and character streams with suitable code samples. (6)
- (b) Describe in detail about exception handling, *try* block and *catch* clause with the help of a suitable Java program. (8)

OR

16.

- (a) Explain object streams in Java. Explain the role of Serializable interface with a suitable code sample. (8)
- (b) Explain *throw*, *throws* and *finally* constructs with the help of a Java program. (6)

17.

(a) Describe in detail the creation of a thread using the Runnable interface and the Thread class with suitable examples. (10)

(b) Explain List Interface. Mention any two exceptions thrown by its methods. (4)

**OR**

18.

(a) Explain in detail the Delegation Event model for event handling in Java. (7)

(b) Write a simple program by extending appropriate class to demonstrate the working of threads in java. (7)

19.

(a) Write a Java program to demonstrate the use of JLabel and JButton by adding them to JFrame. (7)

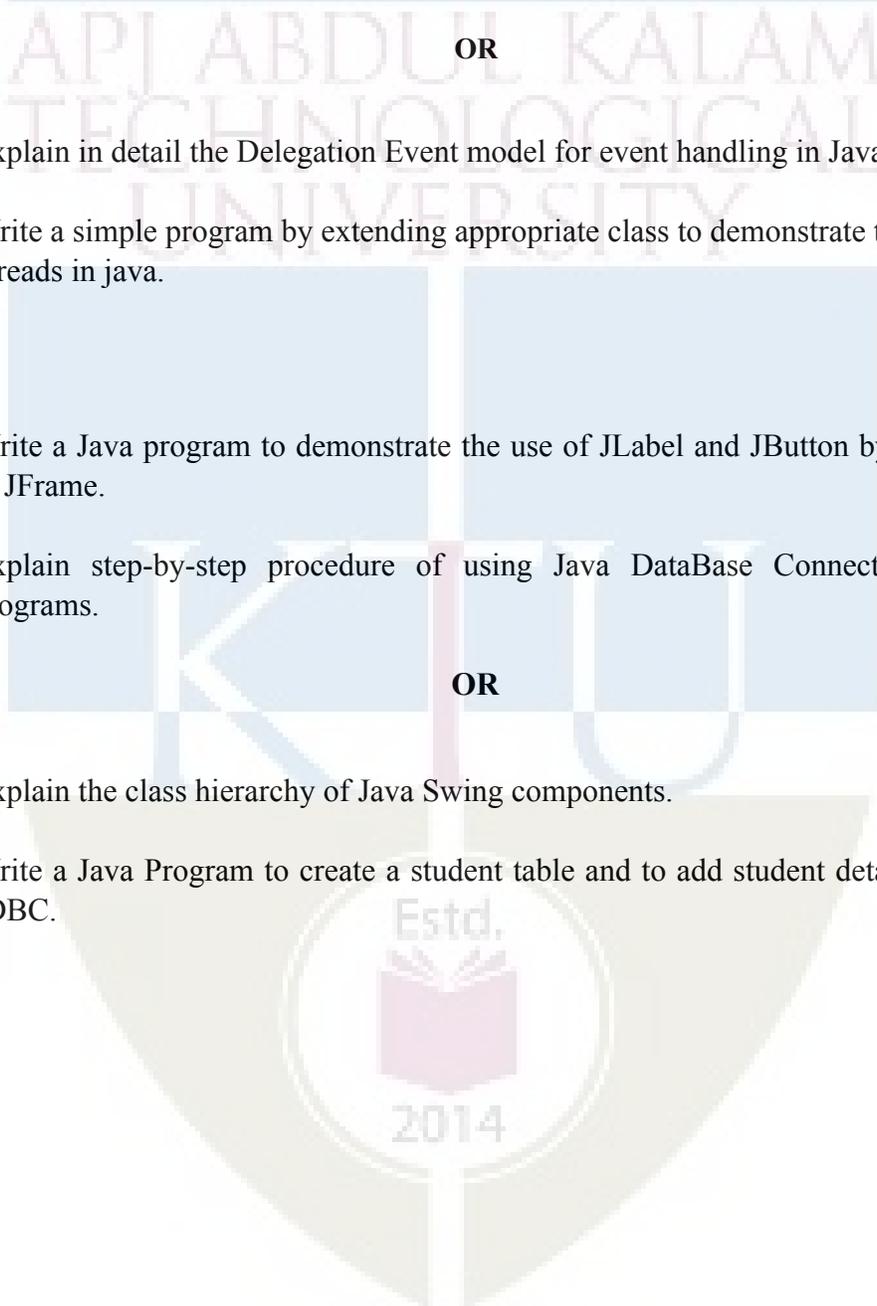
(b) Explain step-by-step procedure of using Java DataBase Connectivity in Java programs. (7)

**OR**

20.

(a) Explain the class hierarchy of Java Swing components. (7)

(b) Write a Java Program to create a student table and to add student details to it using JDBC. (7)



<b>Teaching Plan</b>		
<b>Module 1 : Introduction</b>		(8 hours)
1.1	Approaches to Software Design- Functional Oriented Design, Object-Oriented Design, Case Study of Automated Fire Alarm System.	1 hour
1.2	Object Modeling Using UML – Basic object oriented concepts	1 hour
1.3	Basic object oriented concepts	1 hour
1.4	UML diagrams, Use case model	1hour
1.5	Class diagram, Interaction diagram	1hour
1.6	Activity diagram, State chart diagram	1hour
1.7	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode	1hour
1.8	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues	1hour
<b>Module 2: Core Java Fundamentals</b>		(11 hours)
2.1	Core Java Fundamentals: Primitive Data types, Integers, Floating Point Types, Characters, Boolean	1 hour
2.2	Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.	1 hour
2.3	Operators: Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1 hour
2.4	Control Statements: Selection Statements, Iteration Statements and Jump Statements.	1 hour
2.5	Object Oriented Programming in Java: Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods	1 hour
2.6	Constructors, <i>this</i> Keyword, Method Overloading, Using Objects as Parameters	1 hour
2.7	Returning Objects, Recursion, Access Control, static Members	1 hour

2.8	Final Variables, Inner Classes, Command-Line Arguments, Variable Length Arguments	1 hour
2.9	Inheritance : Super class, Sub class, the keywords <i>super</i> , <i>protected</i> Members,	1 hour
2.10	Calling Order of Constructors, Method Overriding, the Object class,	1 hour
2.11	Abstract Classes and Methods, Using <i>final</i> with Inheritance	1 hour
<b>Module 3: More features of Java</b>		(8 hours)
3.1	Packages and Interfaces: Defining Package, CLASSPATH, Access Protection, Importing Packages	1 hour
3.2	Interfaces	1 hour
3.3	Input / Output: I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class	1 hour
3.4	Object Streams and Serialization	1 hour
3.5	Working with Files	1 hour
3.6	Exception Handling: Checked Exceptions, Unchecked Exceptions, <i>try</i> Block and <i>catch</i> Clause	1 hour
3.7	Multiple <i>catch</i> Clauses, Nested <i>try</i> Statements	1 hour
3.8	<i>throw</i> , <i>throws</i> and <i>finally</i>	1 hour
<b>Module 4: Advanced features of Java</b>		(10 hours)
4.1	Java Library: String Handling – String Constructors, String Length, Special String Operations	1hour
4.2	Character Extraction, String Comparison, Searching Strings, Modifying Strings Using <code>valueOf( )</code> , Comparison of String Buffer and String.	1hour
4.3	Collections framework – Collections overview, Collections Interfaces- Collection Interface	1hour
4.4	List Interface, Collections Class – ArrayList Class	1hour
4.5	Accessing Collections via an Iterator.	1hour
4.6	Event handling: Event Handling Mechanisms, Delegation Event Model	1hour
4.7	Delegation Event Model, Event Classes	1hour

4.8	Sources of Events, Event Listener Interfaces, Using the Delegation Model	1hour
4.9	Multithreaded Programming: The Java Thread Model, The Main Thread, Creating Thread	1hour
4.10	Creating Multiple Threads, Synchronization, Suspending, Resuming and Stopping Threads.	1hour
<b>Module 5: Graphical User Interface and Database support of Java</b>		<b>(8 hours)</b>
5.1	Swings fundamentals, Swing Key Features	1hour
5.2	MVC, Swing Controls, Components and Containers	1hour
5.3	Swing Packages, Event Handling in Swings.	1 hour
5.4	Swing Layout Managers	1hour
5.5	Exploring Swings –JFrame, JLabel, The Swing Buttons, JTextField.	1 hour
5.6	JDBC overview, Creating and Executing Queries – create table, delete, insert, select (Basics only, DBMS course is not a prerequisite).	1hour
5.7	Creating and Executing Queries – create table, delete, insert, select.	1 hour
5.8	Creating and Executing Queries – create table, delete, insert, select.	1 hour



CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
				2	0	0
<b>EST 200</b>	<b>DESIGN AND ENGINEERING</b>					

**Preamble:**

The purpose of this course is to

- i) introduce the undergraduate engineering students the fundamental principles of design engineering,
- ii) make them understand the steps involved in the design process and
- iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

**Prerequisite:**

**Nil.** The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

**Course Outcomes:**

After the completion of the course the student will be able to

<b>CO 1</b>	Explain the different concepts and principles involved in design engineering.
<b>CO 2</b>	Apply design thinking while learning and practicing engineering.
<b>CO 3</b>	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

**Mapping of course outcomes with program outcomes**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
<b>CO 1</b>	2	1					1			1		
<b>CO 2</b>		2				1		1				2
<b>CO 3</b>			2			1	1		2	2		1

**Assessment Pattern****Continuous Internal Evaluation (CIE) Pattern:**

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

**End Semester Examination (ESE) Pattern:** There will be two parts; Part A and Part B.

Part A : 30 marks

part B : 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

**Mark distribution**

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

**Course Level Assessment Questions**

**Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.**

1. State how engineering design is different from other kinds of design
2. List the different stages in a design process.
3. Describe design thinking.
4. State the function of prototyping and proofing in engineering design.
5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design, 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering
6. State design rights.

**Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.**

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.
2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.
3. Describe how a problem-based learning helps in creating better design engineering solutions.
4. Discuss as an engineer, how ethics play a decisive role in your designs

**Course Outcome 3 (CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.**

1. Illustrate the development of any simple product by passing through the different stages of design process
2. Show the graphical design communication with the help of detailed 2D or 3D drawings for any simple product.
3. Describe how to develop new designs for simple products through bio-mimicry.

**Model Question paper**

Page 1 of 2

Reg No.: \_\_\_\_\_ Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY  
THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION**

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100 Duration: 3 Hours

**PART A****Answer all questions, each question carries 3 marks****Use only hand sketches**

- (1) Write about the basic design process.
- (2) Describe how to finalize the design objectives.
- (3) State the role of divergent-convergent questioning in design thinking.
- (4) Discuss how to perform design thinking in a team managing the conflicts.
- (5) Show how engineering sketches and drawings convey designs.
- (6) Explain the role of mathematics and physics in design engineering process.
- (7) Distinguish between project-based learning and problem-based learning in design engineering.
- (8) Describe how concepts like value engineering, concurrent engineering and reverse engineering influence engineering designs?
- (9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?
- (10) Explain how economics influence the engineering designs?

**(10x3 marks =30 marks)****Part B****Answer any ONE question from each module. Each question carry 14 marks****Module 1**

- (11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.
- or**
- (12) Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

**Module 2**

(13) Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14) Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

**Module 3**

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16) Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

**Module 4**

(17) Show the development of a nature inspired design for a solar powered bus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

**Module 5**

(19) Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20) Describe how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) an electrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

**(5x14 marks =70 marks)**

## Syllabus

### Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process:-Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

### Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

### Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

### Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Biomimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

### Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

### Text Books

- 1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,
- 2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

### Reference Books

- 1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

## Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	<b><u>Module 1: Design Process</u></b>	
1.1	Introduction to Design and Engineering Design. <i>What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabulary in engineering design? How to learn and do engineering design.</i>	1
1.2	<i>Defining a Design Process-: Detailing Customer Requirements.</i> <i>How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?</i>	1
1.3	<i>Defining a Design Process-: Setting Design Objectives, Identifying Constraints, Establishing Functions.</i> <i>How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?</i>	1
1.4	<i>Defining a Design Process-: Generating Design Alternatives and Choosing a Design.</i> <i>How to generate or create feasible design alternatives? How to identify the "best possible design"?</i>	1
1.5	Case Studies:- Stages of Design Process. <i>Conduct exercises for designing simple products going through the different stages of design process.</i>	1
2	<b><u>Module 2: Design Thinking Approach</u></b>	
2.1	Introduction to Design Thinking <i>How does the design thinking approach help engineers in creating innovative and efficient designs?</i>	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. <i>How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?</i>	1
2.3	Design Thinking as Divergent-Convergent Questioning. <i>Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.</i>	1
2.4	Design Thinking in a Team Environment. <i>How to perform design thinking as a team managing the conflicts ?</i>	1
2.5	Case Studies: Design Thinking Approach. <i>Conduct exercises using the design thinking approach for</i>	1

	<i>designing any simple products within a limited time and budget</i>	
<b>3</b>	<b><u>Module 3: Design Communication (Languages of Engineering Design)</u></b>	
3.1	Communicating Designs Graphically. <i>How do engineering sketches and drawings convey designs?</i>	1
3.2	Communicating Designs Orally and in Writing. <i>How can a design be communicated through oral presentation or technical reports efficiently?</i>	1
<b>First Series Examination</b>		
3.3	Mathematical Modelling in Design. <i>How do mathematics and physics become a part of the design process?</i>	1
3.4	Prototyping and Proofing the Design. <i>How to predict whether the design will function well or not?</i>	1
3.5	Case Studies: Communicating Designs Graphically. <i>Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.</i>	1
<b>4</b>	<b><u>Module 4: Design Engineering Concepts</u></b>	
4.1	Project-based Learning and Problem-based Learning in Design. <i>How engineering students can learn design engineering through projects?</i> <i>How students can take up problems to learn design engineering?</i>	1
4.2	Modular Design and Life Cycle Design Approaches. <i>What is modular approach in design engineering? How it helps?</i> <i>How the life cycle design approach influences design decisions?</i>	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. <i>How do aesthetics and ergonomics change engineering designs?</i> <i>How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?</i>	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. <i>How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?</i>	1
4.5	Case Studies: Bio-mimicry based Designs. <i>Conduct exercises to develop new designs for simple</i>	1

	<i>products using bio-mimicry and train students to bring out new nature inspired designs.</i>	
5	<b><u>Module 5: Expediency, Economics and Environment in Design Engineering</u></b>	
5.1	Design for Production, Use, and Sustainability. <i>How designs are finalized based on the aspects of production methods, life span, reliability and environment?</i>	1
5.2	Engineering Economics in Design. <i>How to estimate the cost of a particular design and how will economics influence the engineering designs?</i>	1
5.3	Design Rights. <i>What are design rights and how can an engineer put it into practice?</i>	1
5.4	Ethics in Design. <i>How do ethics play a decisive role in engineering design?</i>	1
5.5	Case Studies: Design for Production, Use, and Sustainability. <i>Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.</i>	1
<b>Second Series Examination</b>		



Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	Professional Ethics	2	0	0	2	2

**Preamble:** To enable students to create awareness on ethics and human values.

**Prerequisite:** Nil

**Course Outcomes:** After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

#### Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

#### Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

#### Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

**Continuous Internal Evaluation Pattern:**

Attendance	: 10 marks
Continuous Assessment Tests (2 Nos)	: 25 marks
Assignments/Quiz	: 15 marks

**End Semester Examination Pattern:** There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

**Course Level Assessment Questions****Course Outcome 1 (CO1):**

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

**Course Outcome 2 (CO2)**

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

**Course Outcome 3(CO3):**

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

**Course Outcome 4 (CO4):**

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

**Course Outcome 5 (CO5):**

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explore the need of environmental ethics in technological development.

**Model Question paper**

QP CODE:

Reg No: \_\_\_\_\_

PAGES:3

Name : \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER  
B.TECH DEGREE EXAMINATION, MONTH & YEAR**

Course Code: HUT 200

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100

Duration: 3 Hours

(2019-Scheme)

**PART A****(Answer all questions, each question carries 3 marks)**

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

**PART B****(Answer one full question from each module, each question carries 14 marks)****MODULE I****11. a)** Classify the relationship between ethical values and law?**b)** Compare between caring and sharing.

(10+4 = 14 marks)

**Or****12. a)** Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment.

(8+6 = 14 marks)

### MODULE II

13.a) Explain the three main levels of moral developments, devised by Kohlberg.

b) Differentiate moral codes and optimal codes.

(10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics

(8+6 = 14 marks)

### MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy

(ii) Accountability

b) Explain the rights of employees

(8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty.

(8+6 = 14 marks)

### MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example.

(8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

### MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics.

(8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics.

(8+6 = 14 marks)

## Syllabus

### **Module 1 – Human Values.**

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue- Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment- Empathy-Self Confidence -Social Expectations.

### **Module 2 - Engineering Ethics & Professionalism.**

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg’s theory- Gilligan’s theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

### **Module 3- Engineering as social Experimentation.**

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

### **Module 4- Responsibilities and Rights.**

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality- Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights- Employee right- IPR Discrimination.

### **Module 5- Global Ethical Issues.**

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

### **Text Book**

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

### **Reference Books**

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4<sup>th</sup> edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. <http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics>.

**Course Contents and Lecture Schedule**

<b>SL.No</b>	<b>Topic</b>	<b>No. of Lectures</b> <b>25</b>
<b>1</b>	<b>Module 1 – Human Values.</b>	
1.1	Morals, values and Ethics, Integrity, Academic Integrity, Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
<b>2</b>	<b>Module 2- Engineering Ethics &amp; Professionalism.</b>	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy, Profession & Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
<b>3</b>	<b>Module 3- Engineering as social Experimentation.</b>	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics, Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
<b>4</b>	<b>Module 4- Responsibilities and Rights.</b>	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
<b>5</b>	<b>Module 5- Global Ethical Issues.</b>	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

<b>CODE</b> MCN201	<b>SUSTAINABLE ENGINEERING</b>	<b>CATEGORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>CREDIT</b>
			2	0	0	NIL

**Preamble:** Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

**Prerequisite:** NIL

**Course Outcomes:** After the completion of the course the student will be able to

<b>CO 1</b>	Understand the relevance and the concept of sustainability and the global initiatives in this direction
<b>CO 2</b>	Explain the different types of environmental pollution problems and their sustainable solutions
<b>CO 3</b>	Discuss the environmental regulations and standards
<b>CO 4</b>	Outline the concepts related to conventional and non-conventional energy
<b>CO 5</b>	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

#### Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

#### Assessment Pattern

#### Mark distribution

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

#### Continuous Internal Evaluation Pattern:

Attendance : 10 marks  
 Continuous Assessment Test (2 numbers) : 25 marks  
 Assignment/Quiz/Course project : 15 marks

**End Semester Examination Pattern:** There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

### Course Level Assessment Questions

**Course Outcome 1 (CO1):** Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

**Course Outcome 2 (CO2):** Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

**Course Outcome 3(CO3):** Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. “Nature is the most successful designer and the most brilliant engineer that has ever evolved”. Discuss.

**Course Outcome 4 (CO4):** Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

**Course Outcome 5 (CO5):** Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

### Model Question paper

#### Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.
7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.
9. Enlist some of the features of sustainable habitat.
10. Explain green engineering.

**Part B**

**(Answer one question from each module. Each question carries 14 marks)**

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.  
OR
12. Explain Clean Development Mechanism.
13. Explain the common sources of water pollution and its harmful effects.  
OR
14. Give an account of solid waste management in cities.
15. Explain the different steps involved in the conduct of Environmental Impact Assessment.  
OR
16. Suggest some methods to create public awareness on environmental issues.
17. Comment on the statement, "Almost all energy that man uses comes from the Sun".  
OR
18. Write notes on:
  - a. Land degradation due to water logging.
  - b. Over exploitation of water.
19. Discuss the elements related to sustainable urbanisation.  
OR
20. Discuss any three methods by which you can increase energy efficiency in buildings.

**Syllabus**

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

**Module 1**

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

**Module 2**

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

**Module 3**

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

**Module 4**

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

**Module 5**

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

**Reference Books**

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

## Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

CSL201	DATA STRUCTURES LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3		2

**Preamble:** The aim of the Course is to give hands-on experience for Learners on creating and using different Data Structures. Data Structures are used to process data and arrange data in different formats for many applications. The most commonly performed operations on data structures are traversing, searching, inserting, deleting and few special operations like merging and sorting.

**Prerequisite:** Topics covered under the course Programming in C (EST 102)

CO1	Write a time/space efficient program using arrays/linked lists/trees/graphs to provide necessary functionalities meeting a given set of user requirements ( <b>Cognitive Knowledge Level: Analyse</b> )
CO2	Write a time/space efficient program to sort a list of records based on a given key in the record ( <b>Cognitive Knowledge Level: Apply</b> )
CO3	Examine a given Data Structure to determine its space complexity and time complexities of operations on it ( <b>Cognitive Knowledge Level: Apply</b> )
CO4	Design and implement an efficient data structure to represent given data ( <b>Cognitive Knowledge Level: Apply</b> )
CO5	Write a time/space efficient program to convert an arithmetic expression from one notation to another ( <b>Cognitive Knowledge Level: Apply</b> )
CO6	Write a program using linked lists to simulate Memory Allocation and Garbage Collection ( <b>Cognitive Knowledge Level: Apply</b> )

**Mapping of course outcomes with program outcomes**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

**Assessment Pattern**

<b>Bloom's Category</b>	<b>Continuous Assessment Test (Internal Exam)Percentage</b>	<b>End Semester Examination Percentage</b>
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

**Mark Distribution**

<b>Total Marks</b>	<b>CIE Marks</b>	<b>ESE Marks</b>	<b>ESE Duration</b>
<b>150</b>	<b>75</b>	<b>75</b>	<b>3 hours</b>

**Continuous Internal Evaluation Pattern:**

Attendance	: 15 marks
Continuous Evaluation in Lab	: 30 marks
Continuous Assessment Test	: 15 marks
Viva-voce	: 15 marks

**Internal Examination Pattern:** The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

**End Semester Examination Pattern:** The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

**Operating System to Use in Lab** : Linux

**Compiler/Software to Use in Lab** : gcc

**Programming Language to Use in Lab** : Ansi C

**Fair Lab Record:**

All Students attending the Data Structures Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Data Structure used and the operations performed on them, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

**SYLLABUS**

1. Implementation of Polynomials and Sparse matrices using arrays\*\*
2. Implementation of Stack , Queues, Priority Queues, DEQUEUE and Circular Queues using arrays\*\*
3. Application problems using stacks: Conversion of expression from one notation to another notation . \*\*
4. Implementation of various linked list operations. \*\*
5. Implementation of stack, queue and their applications using linked list.pression
6. Implementation of trees using linked list
7. Representation of polynomials using linked list, addition and multiplication of polynomials. \*\*
8. Implementation of binary trees using linked lists and arrays- creations, insertion, deletion and traversal. \*\*
9. Implementation of binary search trees – creation, insertion, deletion, search
10. Any application programs using trees
11. Implementation of sorting algorithms – bubble, insertion, selection, quick, merge sort

and heap sort.\*\*

12. Implementation of searching algorithms – linear search, binary search.\*\*
13. Representation of graphs and computing various parameters (in degree, out degree etc.) - adjacency list, adjacency matrix.
14. Implementation of BFS and DFS for each graph representations.\*\*
15. Implementation of hash table using your own mapping functions and observe collisions and overflow resolving schemes.\*\*
16. Simulation of first-fit, best-fit and worst-fit allocations.
17. Simulation of a basic memory allocator and garbage collector using doubly linked list.  
\*\* mandatory.

### **DATA STRUCTURES LAB - PRACTICE QUESTIONS**

1. Write a program to read two polynomials and store them in an array. Calculate the sum of the two polynomials and display the first polynomial, second polynomial and the resultant polynomial.
2. C Write a program to enter two matrices in normal form . Write a function to convert two matrices to tuple form and display it. Also find the transpose of the two matrices represented in tuple form and display it. Find the sum of the two matrices in tuple form and display the sum in tuple form.
3. Write a program to enter two matrices in normal form . Write a function to convert two matrices to tuple form and display it. Also find the transpose of the two matrices represented in tuple form and display it. Find the sum of the two matrices in tuple form and display the sum in tuple form.
4. Implement a circular queue using arrays with the operations:
  - 4.1. Insert an element to the queue.
  - 4.2. Delete an elements from the queue.
  - 4.3. Display the contents of the queue after each operation.
5. Implement a Queue using arrays with the operations:

- 5.1. Insert elements to the Queue.
- 5.2. Delete elements from the Queue.
- 5.3. Display the contents of the Queue after each operation.
6. Implement a Stack using arrays with the operations:
  - 6.1. Pushing elements to the Stack.
  - 6.2. Popping elements from the Stack
  - 6.3. Display the contents of the Stack after each operation.
7. Implement a Priority Queue using arrays with the operations:
  - 7.1. Insert elements to the Priority Queue.
  - 7.2. Delete elements from the Priority Queue.
  - 7.3. Display the contents of the Priority Queue after each operation.
8. Implement a Double-Ended Queue (DEQUEUE) with the operations:
  - 8.1. Insert elements to the Front of the queue.
  - 8.2. Insert elements to the Rear of the queue
  - 8.3. Delete elements from the Front of the queue.
  - 8.4. Delete elements from the Rear of the queue.
  - 8.5. Display the queue after each operation.
9. Using stack convert an infix expression to a postfix expression and evaluate the postfix expression.
10. Write a program to convert an infix expression to a prefix expression using stacks.
11. Convert an infix expression to a postfix expression without using a stack
12. Write a menu driven program for performing the following operations on a Linked List:
  - 12.1. Display
  - 12.2. Insert at Beginning
  - 12.3. Insert at End
  - 12.4. Insert at a specified Position
  - 12.5. Delete from Beginning
  - 12.6. Delete from End
  - 12.7. Delete from a specified Position
13. Implement a stack using linked list with the operations:
  - 13.1. Push elements to the queue.
  - 13.2. Pop elements from the queue.
  - 13.3. Display the queue after each operation.
14. Implement a Queue using linked list with the operations:

- 14.1. Insert an element to the queue.
  - 14.2. Delete an element from the queue.
  - 14.3. Display the queue after each operation.
15. Write a program to reverse the content of queue using stack
  16. Write a program to read two polynomials and store them using linked list. Calculate the sum of the two polynomials and display the first polynomial, second polynomial and the resultant polynomial.
  17. Write a program to read two polynomials and store them using linked list. Find the product of two polynomials and store the result using linked list. Display the resultant polynomial.
  18. Write a program for addition of polynomials containing two variables using linked list.
  19. The details of students (number, name, total-mark) are to be stored in a linked list. Write functions for the following operations:
    - 19.1. Insert
    - 19.2. Delete
    - 19.3. Search
    - 19.4. Sort on the basis of number
    - 19.5. Display the resultant list after every operation
  20. Create a Doubly Linked List from a string taking each character from the string. Check if the given string is palindrome in an efficient method.
  21. Create a binary tree with the following operations
    - 21.1. Insert a new node
    - 21.2. Inorder traversal.
    - 21.3. Preorder traversal.
    - 21.4. Postorder traversal.
    - 21.5. Delete a node.
  22. Write a program to create a binary search tree and find the number of leaf nodes
  23. Create a binary search tree with the following operations:
    - 23.1. Insert a new node .
    - 23.2. Inorder traversal.
    - 23.3. Preorder traversal.
    - 23.4. Postorder traversal.
    - 23.5. Delete a node.

24. Write a program to sort a set of numbers using a binary tree.
25. Represent any given graph and
- 25.1. Perform a depth first search .
  - 25.2. Perform a breadth first search
26. Create a text file containing the name, height, weight of the students in a class. Perform Quick sort and Merge sort on this data and store the resultant data in two separate files. Also write the time taken by the two sorting methods into the respective files.
- Eg.
- |              |     |    |
|--------------|-----|----|
| Sony Mathew  | 5.5 | 60 |
| Arun Sajeev  | 5.7 | 58 |
| Rajesh Kumar | 6.1 | 70 |
27. Write a program to sort a set of numbers using Heap sort and find a particular number from the sorted set using Binary Search.
28. Implement a Hash table using Chaining method. Let the size of hash table be 10 so that the index varies from 0 to 9.
29. Implement a Hash table that uses Linear Probing for collision resolution



CSL 203	OBJECT ORIENTED PROGRAMMING LAB (IN JAVA)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3		2

**Preamble:** The aim of the course is to provide hands-on experience to the learners on various object oriented concepts in Java Programming. This course helps the learners to enhance the capability to design and implement various Java applications for real world problems.

**Prerequisite:** Topics covered under the course Programming in C (EST 102)

### Course Outcomes:

At the end of the course, the student should be able to

CO1	Implement the Object Oriented concepts - constructors, inheritance, method overloading & overriding and polymorphism in Java (Cognitive Knowledge Level: <b>Apply</b> )
CO2	Implement programs in Java which use datatypes, operators, control statements, built in packages & interfaces, Input/Output streams and Files (Cognitive Knowledge Level: <b>Apply</b> )
CO3	Implement robust application programs in Java using exception handling (Cognitive Knowledge Level: <b>Apply</b> )
CO4	Implement application programs in Java using multithreading and database connectivity (Cognitive Knowledge Level: <b>Apply</b> )
CO5	Implement Graphical User Interface based application programs by utilizing event handling features and Swing in Java (Cognitive Knowledge Level: <b>Apply</b> )

### Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	☑	☑	☑	☑	☑			☑		☑		☑
CO2	☑	☑	☑	☑	☑			☑		☑		☑
CO3	☑	☑	☑	☑	☑			☑		☑		☑
CO4	☑	☑	☑	☑	☑			☑		☑		☑
CO5	☑	☑	☑	☑	☑			☑		☑		☑

<b>Abstract POs defined by National Board of Accreditation</b>			
<b>PO#</b>	<b>Broad PO</b>	<b>PO#</b>	<b>Broad PO</b>
<b>PO1</b>	Engineering Knowledge	<b>PO7</b>	Environment and Sustainability
<b>PO2</b>	Problem Analysis	<b>PO8</b>	Ethics
<b>PO3</b>	Design/Development of solutions	<b>PO9</b>	Individual and team work
<b>PO4</b>	Conduct investigations of complex problems	<b>PO10</b>	Communication
<b>PO5</b>	Modern tool usage	<b>PO11</b>	Project Management and Finance
<b>PO6</b>	The Engineer and Society	<b>PO12</b>	Life long learning

### Assessment Pattern

<b>Bloom's Category</b>	<b>Continuous Assessment Test - Internal Exam (Percentage)</b>	<b>End Semester Examination (Percentage)</b>
Remember	20	20
Understand	20	20
Apply	60	60
Analyse		
Evaluate		
Create		

### Mark Distribution

<b>Total Marks</b>	<b>CIE Marks</b>	<b>ESE Marks</b>	<b>ESE Duration</b>
<b>150</b>	<b>75</b>	<b>75</b>	<b>3 hours</b>

**Continuous Internal Evaluation Pattern:**

Attendance	: 15 marks
Continuous Evaluation in Lab	: 30 marks
Continuous Assessment Test	: 15 marks
Viva-voce	: 15 marks

**Internal Examination Pattern:** The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

**End Semester Examination Pattern:** The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

**Operating System to Use in Lab** : Linux

**Compiler/Software to Use in Lab** : gcc, javac, jdk, jre, Eclipse, NetBeans,  
MySQL / PostgreSQL.

**Programming Language to Use in Lab** : Java

**Fair Lab Record:**

All Students attending the Object Oriented Programming Lab (in Java) should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Operations Performed, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

**SYLLABUS**

The syllabus contains six sessions (A, B, C, D, E, F). Each session consists of three concrete Java exercises, out of which at least two questions are mandatory.

**(A)** Basic programs using datatypes, operators, and control statements in Java.

- 1) Write a Java program that checks whether a given string is a palindrome or not.  
Ex: MALAYALAM is palindrome.
- 2) Write a Java Program to find the frequency of a given character in a string. \*\*
- 3) Write a Java program to multiply two given matrices. \*\*

**(B)** Object Oriented Programming Concepts: Problem on the use of constructors, inheritance, method overloading & overriding, polymorphism and garbage collection:

- 4) Write a Java program which creates a class named 'Employee' having the following members: Name, Age, Phone number, Address, Salary. It also has a method named 'printSalary( )' which prints the salary of the Employee. Two classes 'Officer' and 'Manager' inherits the 'Employee' class. The 'Officer' and 'Manager' classes have data members 'specialization' and 'department' respectively. Now, assign name, age, phone number, address and salary to an officer and a manager by making an object of both of these classes and print the same. (Exercise to understand inheritance). \*\*
- 5) Write a java program to create an abstract class named Shape that contains an empty method named numberOfSides( ). Provide three classes named Rectangle, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method numberOfSides( ) that shows the number of sides in the given geometrical structures. (Exercise to understand polymorphism). \*\*
- 6) Write a Java program to demonstrate the use of garbage collector.

**(C)** Handling different types of files as well as input and output management methods:

- 7) Write a file handling program in Java with reader/writer.
- 8) Write a Java program that read from a file and write to file by handling all file related exceptions. \*\*
- 9) Write a Java program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use String Tokenizer class of java.util). \*\*

**(D)** Exception handling and multi-threading applications:

- 10) Write a Java program that shows the usage of try, catch, throws and finally. \*\*
- 11) Write a Java program that implements a multi-threaded program which has three threads. First thread generates a random integer every 1 second. If the value is even, second thread computes the square of the number and prints. If the value is odd the third thread will print the value of cube of the number.
- 12) Write a Java program that shows thread synchronization. \*\*

**(E) Graphics Programming:**

- 13) Write a Java program that works as a simple calculator. Arrange Buttons for digits and the + - \* % operations properly. Add a text field to display the result. Handle any possible exceptions like divide by zero. Use Java Swing. \*\*
- 14) Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time. No light is on when the program starts. \*\*
- 15) Write a Java program to display all records from a table using Java Database Connectivity (JDBC).

**(F) Standard Searching and Sorting Algorithms using data structures and algorithms learned from course Data Structures (CST 201):**

- 16) Write a Java program for the following: \*\*
  - 1) Create a doubly linked list of elements.
  - 2) Delete a given element from the above list.
  - 3) Display the contents of the list after deletion.
- 17) Write a Java program that implements Quick sort algorithm for sorting a list of names in ascending order. \*\*
- 18) Write a Java program that implements the binary search algorithm.

\*\* Mandatory

**PRACTICE QUESTIONS**

- 1) Write a Java program to reverse an given string.
- 2) Write a Java program to display the transpose of a given matrix.
- 3) Write a Java program to find the second smallest element in an array.
- 4) Write a Java program to check whether a given number is prime or not.
- 5) Write a Java program to calculate the area of different shapes namely circle, rectangle, and triangle using the concept of method overloading.
- 6) Write two Java classes Employee and Engineer. Engineer should inherit from Employee class. Employee class to have two methods display() and calcSalary(). Write a program to display the engineer salary and to display from Employee class using a single object instantiation (i.e., only one object creation is allowed).
  - display() only prints the name of the class and does not return any value. Ex. “ Name of class is Employee.”
  - calcSalary() in Employee displays “Salary of employee is 10000” and calcSalary() in Engineer displays “Salary of employee is 20000.”
- 7) Write a Java program to illustrate Interface inheritance.
- 8) Write a Java program that shows how to create a user-defined exception.
- 9) Write a Java program to create two threads: One for displaying all odd number between 1 and 100 and second thread for displaying all even numbers between 1 and 100.
- 10) Write a Java program that shows thread priorities.
- 11) Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
- 12) Write a Java program that displays the number of characters, lines and words in a text file.
- 13) Write a Java program for handling mouse events.
- 14) Write a Java program for handling key events using Adapter classes (general).
- 15) Write a Java program that allows the user to draw lines, rectangles and ovals.
- 16) Write a Java Swing program to print a wave form on the output screen.
- 17) Write a program to accept rollno, name, CGPA of “n” students and store the data to a database using JDBC connectivity. Display the list of students having CGPA greater than 7. (Use MySQL /PostgreSQL).
- 18) Write a Java program to implement Heap sort algorithm using array.